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Terry Holesinger

*Conducting physics and materials science
for energy-efficient technologies*

By Diana Del Mauro
ADEPS Communications

Terry Holesinger is a pro at heading up new scientific ventures with industry and delivering real-world solutions. For nearly two decades he helped jump-start the development of high-temperature superconducting cables for the electric power industry. American Superconductor is putting the results of his research to work on the Long Island power grid.

Now, using his physics and materials science expertise, he leads a new challenge—to design, with Chevron, carbon nanotube composite conductors for high-power applications in the oil services industry.

“If successful, this could be a breakthrough technology that helps with energy-saving transmission of power,” said Holesinger, of the Superconductivity Technology Center (MPA-STC).



In this latest venture, Holesinger's vision for new sources of electricity will dive deep—nearly a league under the sea. Pure copper cable, the only option available today for powering deep-sea oil well pumps, often doesn't provide enough conductivity in a size that fits into the narrow opening of a well. When faced with such obstacles, Chevron either cancels plans to develop a well or reduces the power requirements, thereby limiting the amount of oil the well will produce, says Steve Andre of Houston-based Chevron Energy Technology Company.

By 2014, Chevron hopes to have better options if Los Alamos scientists can fabricate a 100-meter section of carbon nanotube cable with a 100-percent conductivity enhancement relative to pure copper. A greener energy source, the composite conductors would use

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“Our strategic goal is to seek out new opportunities by combining our capabilities, and to provide our staff with an intellectually stimulating environment to pursue new ideas and programs.”



Ken Marken has announced that he will be taking a job with the DOE Office of High Energy Physics in March. We wish Ken well in this new endeavor. Ken has played a central role in managing MPA-STC and in the substantial contributions of that group to applied superconductivity. Under Ken's leadership, the Superconductivity Technology Center (STC) excelled in its role of developing advanced superconductor tape technology by understanding fundamental physics, such as vortex phenomena, and discovering techniques to control manufacturing processes to optimize performance. The combination of practical understanding of technical needs and basic science enabling novel technology made STC's program unique and made STC a desirable industrial partner. The unfortunate demise of the applied superconductivity program in the DOE Office of Electricity Delivery and Energy Reliability has meant that STC has needed to diversify its programs. Ken has worked diligently with his staff to accomplish a great deal towards this goal over the last year. Several new programs have been initiated, most notably efforts to develop novel conventional conductors (see the cover article highlighting Terry Holesinger). Ken's leadership and support for this effort have been critical and will be missed. We are grateful for what he has accomplished.

With Ken's departure, MPA must now come to terms with how we can best organize our resources to execute our programs and position ourselves for new opportunities. We believe the time has come to dissolve STC, but we would like to do so in a way that is beneficial to our employees and to the vitality of the Division. Our

strategic goal is to seek out new opportunities by combining our capabilities, and to provide our staff with an intellectually stimulating environment to pursue new ideas and programs. We see synergies among the work done by STC personnel and ongoing efforts across the Division. At this time, we think we gain the most if the majority of STC personnel join MPA-MC to broaden the capability of that group to Materials Chemistry and Physics. STC's vortex physics team has more commonality with MPA-CMMS, and hence will move there.

We anticipate an additional advantage to the restructuring of MPA because it will enable us to apply our management resources more uniformly across the Division. As part of the restructuring, we will be looking for a deputy group leader for the expanded MPA-MC. In the interim, we are asking Jeff Willis to fulfill this role. Mark McCleskey is a part-time group leader, devoting significant effort to MaRIE. Additional management bandwidth in MPA-MC should enhance the support for all employees in the combined group.

We will work with STC personnel throughout the month of February to ensure that we find the best solution for each employee. We also believe it is important to engage across all groups so that we can optimize the outcome of this re-organization for the MPA. We welcome your help in making this transition successful.

*MPA Division Leader Toni Taylor and
MPA Deputy Division Leader David Watkins*

Holesinger... half as much copper. And long-range, this type of cable might be able to transmit megawatts of power from an offshore platform to a pump 100 miles away.

"We've seen promising results that make us excited," Andre said, adding "everyone is cautiously optimistic" as researchers strive to overcome the challenges of working with a material so tiny—a building block 100,000 times smaller than the width of a strand of hair.

Andre noted that Holesinger's strong leadership skills are important as he collaborates with a diverse group of people—physicists, chemists, materials scientists, electrical engineers, mechanical engineers, and technicians—to develop the carbon nanotube composite conductors.

Superconductivity was the first solution considered but due to liquid nitrogen cooling issues, it wouldn't work. That's when Los Alamos scientists "had a great idea," project manager Andre said: Boost the cable's conductivity by using carbon nanotubes. Because of their low energy dissipation, carbon nanotubes can potentially carry up to 10,000 times greater current densities than superconducting wires.

Self-described "blue-collar" scientist

"Even though my degree is in physics, most of the stuff I do these days is materials. It's not been your typical career," said Holesinger, who has a PhD in applied physics from Iowa State University but enjoys making samples, wires, and composite materials in labs he built from scratch.

He calls himself a "blue-collar scientist" because he is passionate about helping American industry transform ideas into technological and manufacturing solutions. In a mix of basic, applied, and proprietary work, Holesinger, who has been with MPA-STC for 19 years and materials development team leader since 2006, has forged collaborations with national laboratories, academia, and start-up companies. He is currently the principal investigator of LANL's longest running industrial collaboration, which is entering its 23rd year.

Despite a full plate of proprietary work, Holesinger has produced 130 publications, with more than 1,900 citations, and 10 patents. He is the recipient of a 2010 R&D 100 Award, a 2001 award from the Federal Consortium for Technology Transfer, and 3 Laboratory Achievement Awards. Holesinger has also garnered four top-ranked presentations at the competitive annual peer review of the DOE Superconductivity Programs for Electric Power.

At the end of the day, Holesinger finds it satisfying to hold a wire he made in his hand, not just a research paper. Better still, he is thrilled when he can say, "Here's your answer, and you can install it."

Terry Holesinger's Favorite Experiment

What: Many of the materials he works with depend upon the structure at the nanoscale. As such, he relies on electron microscopy (SEM, TEM, STEM) as an important characterization tool in his work.

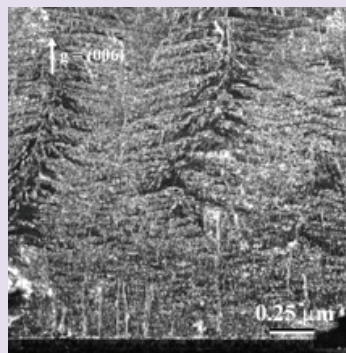
Why: "Strolling" through the microstructure one nanometer at a time gives one a full appreciation of the diversity of structure, including the extremes, one can find in any material. These extremes have often been a source for new ideas in materials development.

When: Holesinger's favorite experiment is still ongoing.

Where: Los Alamos Superconductivity Technology Center

How: His favorite example is explaining why world record high-temperature superconducting (HTS) films produced at LANL worked so well using a single micrograph (see figure). HTS films depend explicitly upon a uniform dispersion of nano-sized defects, the so-called pinning centers for impeding vortex motion in the presence of magnetic fields.

The a-ha moment: As the saying goes, a picture says a thousand words; the visual relationship between the nanostructure in the HTS films and associated properties is a story unto itself.



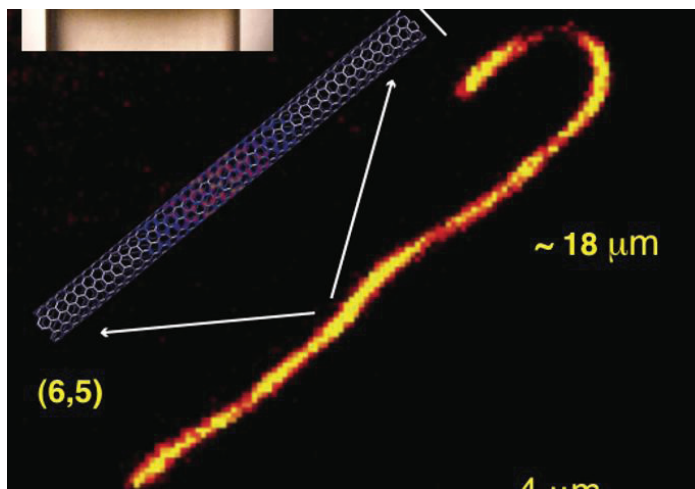
A dark-field, weak beam TEM image showing the dispersion of nanoparticles and nanorods in a record 2 micron thick YBCO film that had a J_c of 5 MA/cm² at liquid nitrogen temperatures. This "low magnification" image shows a uniform dispersion of nanoparticles both laterally and through thickness.

Los Alamos scientists detect and track single molecules with nanoscale carbon cylinders

Many physical and chemical processes necessary for biology and chemistry occur at the interface of water and solid surfaces. Researchers at Los Alamos National Laboratory publishing in Nature Nanotechnology have now shown that semiconducting carbon nanotubes—light emitting cylinders of pure carbon—have the potential to detect and track single molecules in water.

Using high-speed microscopic imaging, they found that nanotubes could both detect and track the motion of individual molecules as they bombard the surface at the water interface. Traditional

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A photoluminescence image of a carbon nanotube with an artist's illustration of the structure.

Detect... techniques to investigate molecules on surfaces cannot be used in water because the study requires low-pressure atmospheres such as one finds in space. The team is hopeful that their work will lead to practical, nanotube-based, single-molecule detectors in aqueous biological and chemical environments.

Molecular motion and attachment to surfaces is important for driving chemistry that ranges from the production of ammonia on metal to the enzymatic oxidation of glucose. The attachment takes place through sporadic motion followed by a collision with the surface to which the molecule sticks. Molecules can then move along the surface where they can collide with other molecules and undergo chemical reactions.

In traditional "surface science" experiments these processes are imaged in a vacuum where other molecular species from the air cannot blur the image. In solutions such as water, there has been no way to do this directly. Consequently, researchers have been searching for a material that can be used in water to detect individual molecules for surface-science applications.

Inspired by this challenge, a team of Los Alamos scientists Jared Crochet, Juan Duque (Physical Chemistry & Applied Spectroscopy, C-PCS) and Jim Werner, and Steve Doorn (Center For Integrated Nanotechnologies, MPA-CINT) explored using light-emitting carbon nanotubes as detectors. With techniques developed by others, the team used soap and water to stabilize the nanotubes where they could be imaged directly with a high-speed video camera. When illuminated with laser light, these tubes shine brightly, like long glow sticks.

When the glowing nanotubes are exposed in water to different chemicals, the researchers saw that certain spots of the tube would briefly go dim as the molecules bombarded the surface. This allowed them to determine how effectively certain molecules would stick to the surface. The researchers were also able to track the

motion of molecules as they moved along the surface. The team is now examining how chemical reactions proceed on nanotube surfaces to better understand chemistry at the water interface for biological and chemical applications.

Reference: "Photoluminescence imaging of electronic impurity-induced exciton quenching in single-walled carbon nanotubes," *Nature Nanotechnology* 7 126-132 (2012).

This research was performed at the Center for Integrated Nanotechnologies, a DOE Office of Basic Energy Sciences user facility. The work supports the Lab's Energy Security and Global Security mission areas and the Science of Signatures and Materials for the Future science pillars.

Jia and Kiplinger selected as AAAS Fellows

The American Association for the Advancement of Science (AAAS) has awarded the distinction of Fellow to Quanxi Jia and Jaqueline Kiplinger for advancing science applications that are deemed scientifically or socially distinguished.

Jia (MPA-CINT) was recognized for pioneering contributions to thin film electronic devices and multifunctional metal-oxide films, and for distinguished service to the materials research profession.

Kiplinger (Materials Chemistry, MPA-MC) was recognized for , distinguished contributions to the field of actinide and lanthanide science, especially in the area of chemical synthesis of novel actinide-containing molecules.

New Fellows will be recognized this month at the AAAS Fellows Forum during the 2012 AAAS Annual Meeting in Vancouver, B.C., Canada.



Quanxi Jia



Jaqueline Kiplinger

Jaime named 2011 APS Fellow

The American Physical Society (APS) has selected Marcelo Jaime (Condensed Matter and Magnet Science, MPA-CMMS) as a 2011 Fellow. Jaime was honored "For pioneering techniques in the study of thermal properties of materials in high pulsed magnetic fields and for contributions to the understanding of colossal

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APS... magnetoresistance compounds, Kondo insulators, correlated-electron systems, and quantum magnets."

The APS is a nonprofit organization working to advance the knowledge of physics through its research journals, scientific meetings, outreach, advocacy, and international activities. It represents 48,000 members worldwide, including physicists in academia, national laboratories, and industry. Only half of one percent of APS members can be elected to Fellowship yearly.



Marcelo Jaime



220th ECS Meeting

Boston
Massachusetts
October 9-14, 2011



LANL fuel cell research center stage at society meeting

Los Alamos led the national laboratories in presentations on fuel cell research at the 220th Electrochemical Society Meeting, which drew 3,000 participants this fall in Boston.

In 14 presentations and 7 published transaction papers, Los Alamos scientists covered applied and fundamental aspects of fuel cell, sensor, and battery materials research and development.

In an invited talk allotted twice the time for standard presentations, materials chemist Rangachary Mukundan (Sensors and Electrochemical Devices Division, MPA-11) presented a summary of his Department of Energy-funded project that correlates the results of accelerated stress tests performed in the laboratory with data obtained by Ballard Power Systems on fuel cell buses that have operated in the field for several years. These results give developers an important tool to rapidly screen new materials, allowing crucial advancement of polymer electrolyte membrane (PEM) fuel cell durability in order to meet DOE 2015 targets.

Other reports on fuel cell durability included catalyst layer ionomer degradation by Rod Borup, electrode structure effect on membrane degradation by Christina Johnston, characterization of carbon corrosion by Dusan Spornjak, and durability effect on water retention in operating fuel cells by Joe Fairweather (all MPA-11). Presenting research on new electrocatalysts and fuel cells for portable power were Gang Wu, Jerzy Chlistunoff, Christina

Johnston, Yu Seung Kim, and Piotr Zelenay (all MPA-11), as well as Jose-Maria Sansinena (Chemical Diagnostics & Engineering, C-CDE). Ivana Matanovic (Physics & Chemistry of Materials, T-1) also presented a talk on electrochemical processes on novel platinum group metal catalysts.

The Electrochemical Society is a nonprofit international organization concerned with a broad range of phenomena relating to electrochemical and solid-state science and technology.

Technical contact: Rod Borup

HeadsUP!

Report slippery spots to 667-6111

With more than 37 slip/trip accidents since December 1, and a cycle of freezing and thawing creating new ice spots every day, safety managers want to remind employees that anyone can and should use the Snow Control hotline to report slippery spots: call 667-6111. Crews from Roads & Grounds will be dispatched as soon as possible to address the problem.

New phone service at Occupational Medicine

LANL workers can call one number at Occupational Medicine for questions about medical issues. The new number, 667-0660, gives callers a series of prompts they can follow to obtain services from Occupational Medicine medical staff.

Congratulations to the following MPA employees celebrating service anniversaries recently:

Juanita Armijo, MPA-CMMS	40 years
John Davey, MPA-11	20 years
Roman Movshovich, MPA-CMMS	20 years
Rangachary Mukundan, MPA-11	15 years
Kathryn Berchtold, MPA-MC	10 years
Leonardo Civalle, MPA-STC	10 years
MD Azad, MPA-CINT	5 years

MPA Materials Matter

is published by the Experimental Physical Sciences Directorate. To submit news items or for more information contact Karen Kippen, ADEPS Communications Team, 606-1822, or kkippen@lanl.gov. LALP-12-011



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